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(54) **FIXER THAT FORMS A NIP WITH AN INDUCTION-HEATED BELT AND AN IMAGE FORMING APPARATUS HAVING THE SAME**

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G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/2053*** (2013.01)

(58) **Field of Classification Search**
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USPC 399/329
See application file for complete search history.

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(57) **ABSTRACT**

A fixer includes a fixing belt configured to move around a center, a heating unit configured to induction-heat the fixing belt, a pressing member that presses an outer surface of the fixing belt, a resilient member disposed opposite to the pressing member across the fixing belt, and a heat generating member that is capable of being induction-heated and disposed along the inner surface of the fixing belt between a first position and a second position that is downstream with respect to the first position in a moving direction of the fixing belt. An upstream end portion of the resilient member in the moving direction is in contact with a third position of the fixing belt, and an angle formed with respect to the center by the second and third positions is equal to or smaller than 60°.

20 Claims, 7 Drawing Sheets

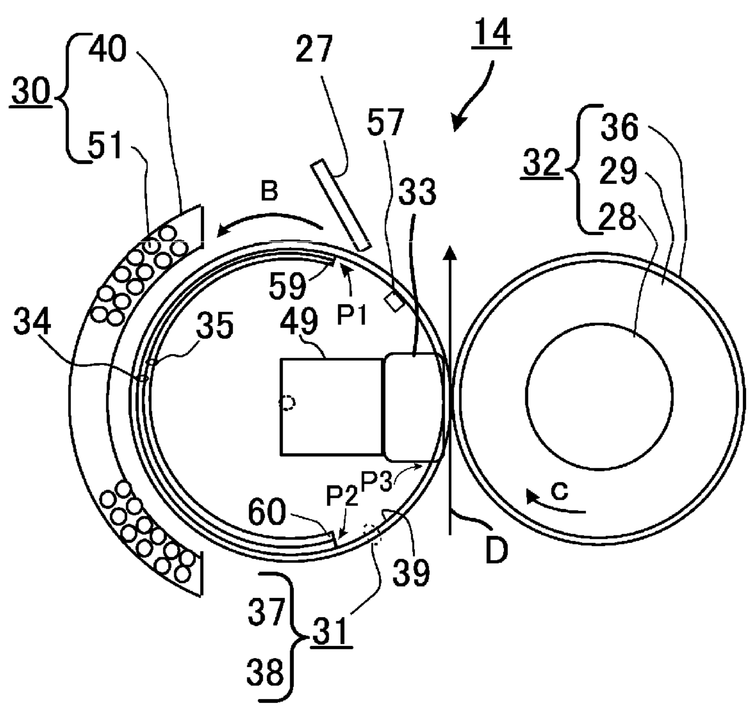
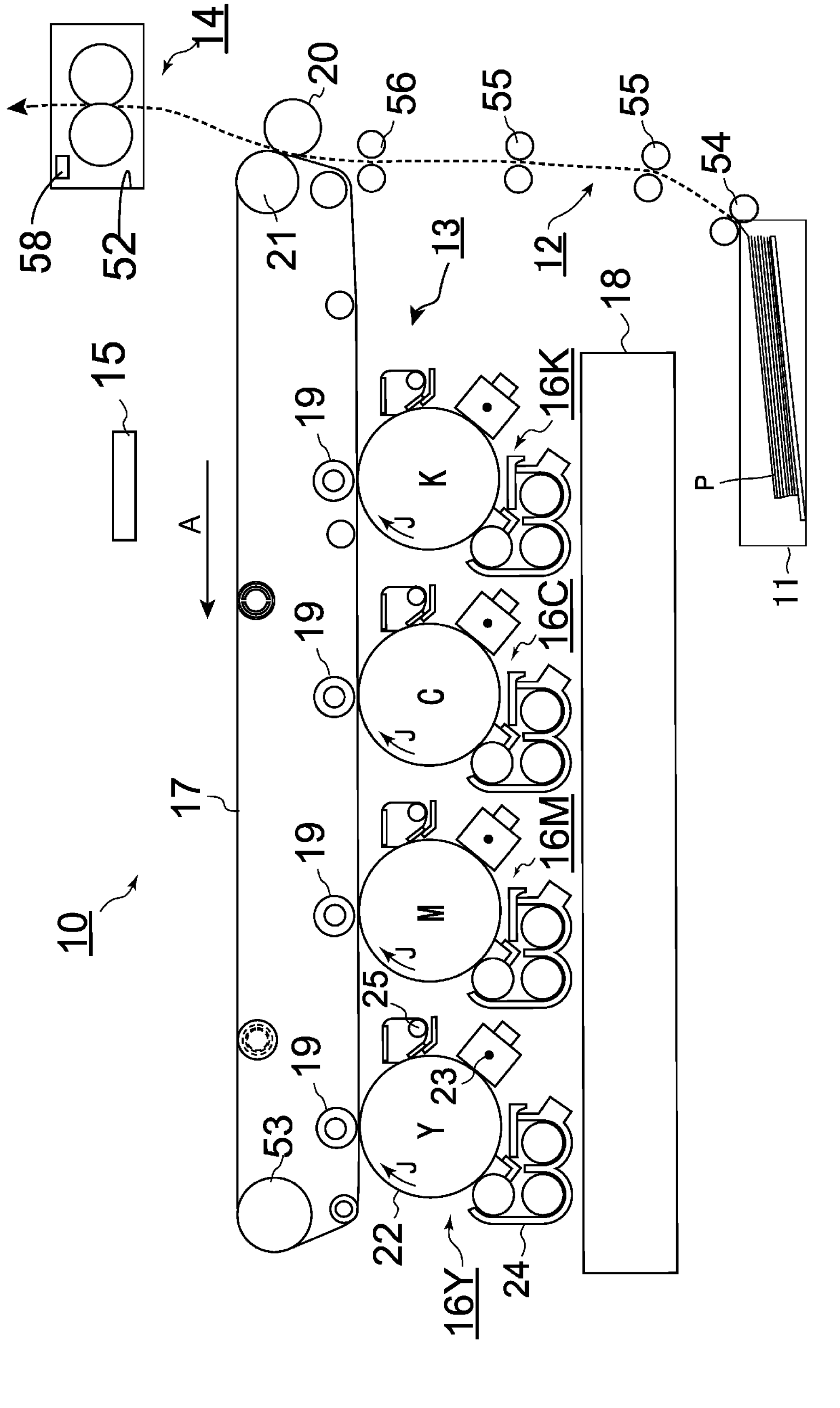


FIG. 1



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16K
16C
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P
11

FIG. 2

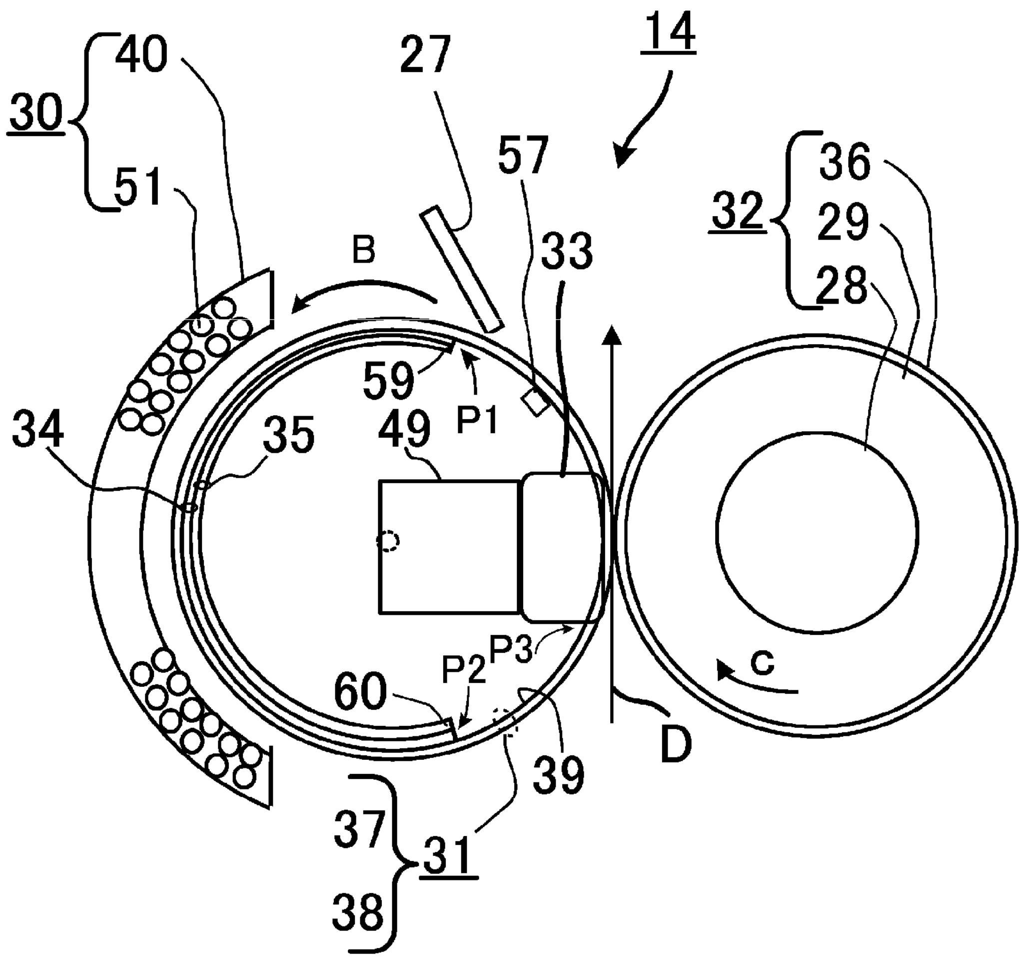

FIG. 3

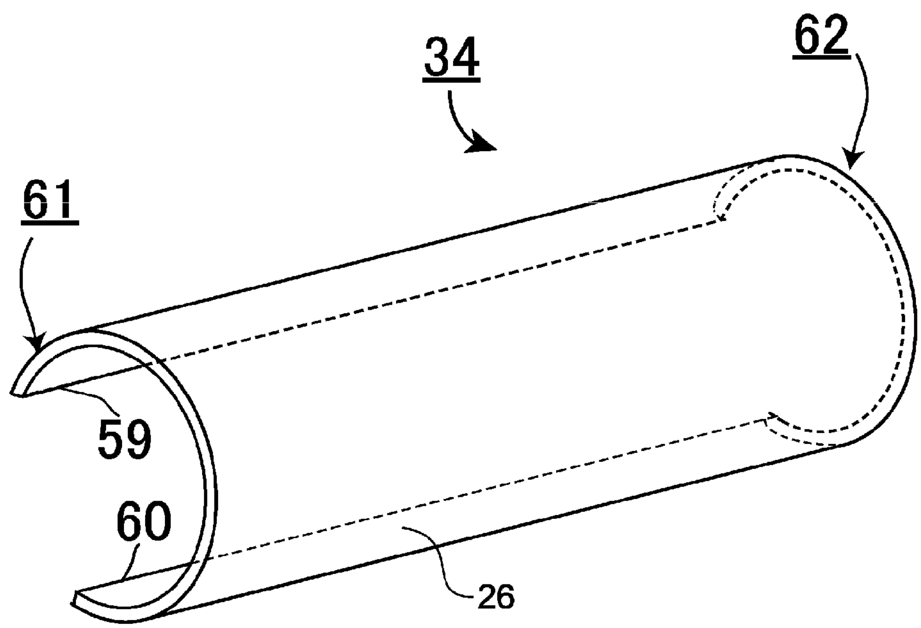

FIG. 4

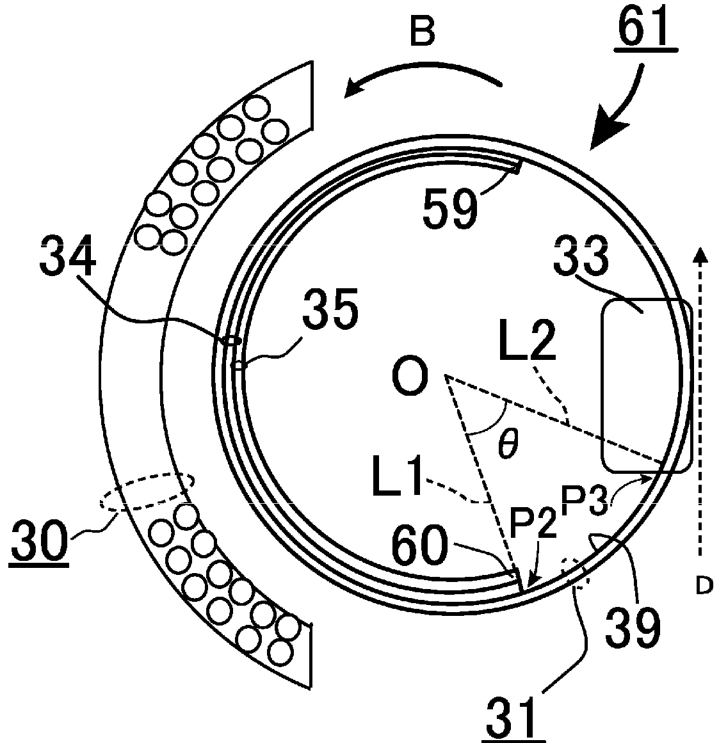

FIG. 5

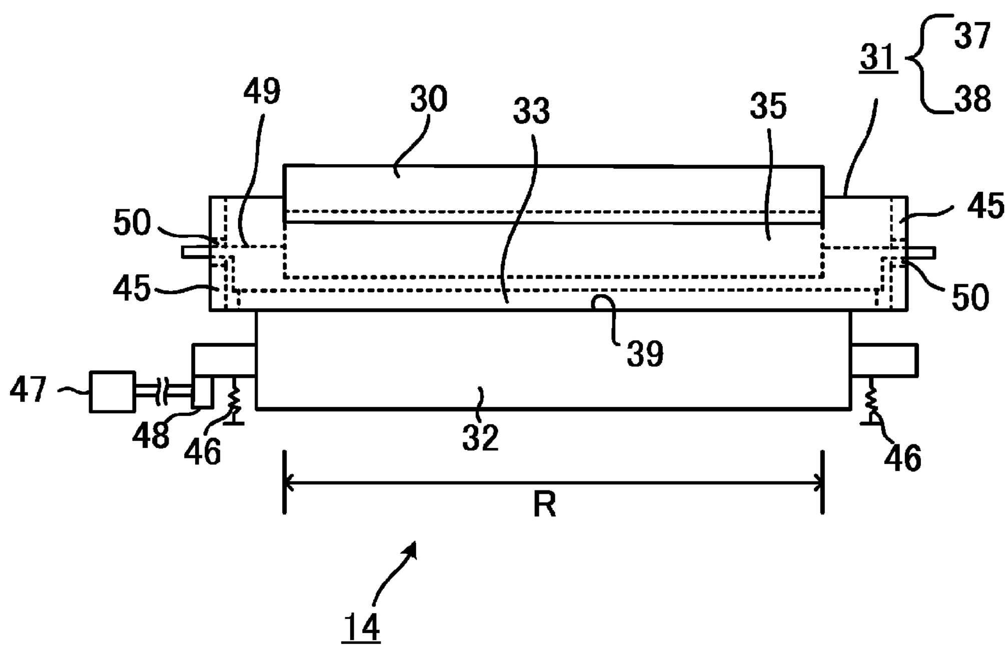

FIG. 6

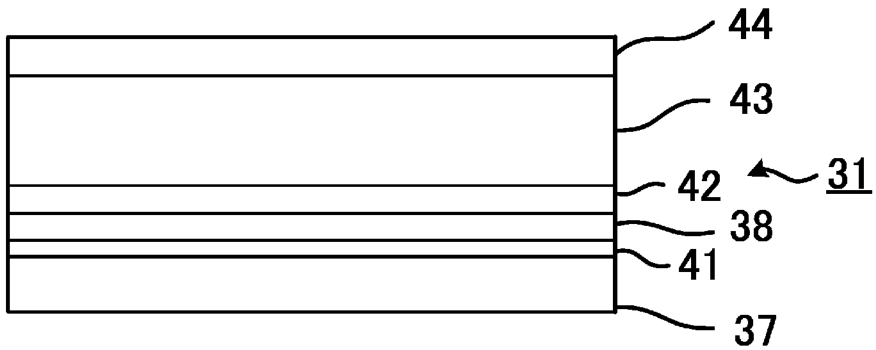

FIG. 7

ANGLE θ (degree)	LIFE DURATION OF FIXING BELT (NUMBER OF SHEETS)
100°	7K SHEETS
80°	21K SHEETS
60°	GREATER THAN 200K SHEETS
40°	GREATER THAN 200K SHEETS
20°	GREATER THAN 200K SHEETS

FIXER THAT FORMS A NIP WITH AN INDUCTION-HEATED BELT AND AN IMAGE FORMING APPARATUS HAVING THE SAME

FIELD

Embodiments described herein relate generally to a fixer and an image forming apparatus.

BACKGROUND

In one type of a fixer that is used to fix an image on a sheet, electromagnetic induction heating (IH) is employed to heat a fixing belt using a magnetic flux from an exciting coil. The fixer of this type typically includes the fixing belt, a pressing member, a fixing pad, a heat generating element, and an exciting coil. The fixing pad is urged towards an inner surface of the fixing belt to form a nip, and the heat generating element, which is disposed along the inner surface of the fixing belt, generates heat through the electromagnetic induction heating. However, a crack may be produced in a layer of the fixing belt while the fixer is used. As a result, the fixing belt having the crack may have a region that cannot generate sufficient amount of heat to fix the image. Further, another region of the cracked fixing belt may generate excessive amount of heat, and, as a result, the fixing belt may be damaged.

DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an image forming apparatus according to one embodiment.

FIG. **2** illustrates a fixer according to the embodiment.

FIG. **3** is a perspective view of a heat generating element of the fixer according to the embodiment.

FIG. **4** illustrates a positional relationship between the heat generating element and an urging member of the fixer according to the embodiment.

FIG. **5** is a top view of the fixer according to the embodiment.

FIG. **6** illustrates a layer structure of a fixing belt of the fixer according to the embodiment.

FIG. **7** illustrates a relationship between a central angle of an arc where the heat generating member is not formed and life duration of the fixing belt.

DETAILED DESCRIPTION

According to one or more embodiments, a fixer includes a fixing belt configured to move around a center, a heating unit configured to induction-heat the fixing belt, a pressing member that presses an outer surface of the fixing belt, a resilient member disposed opposite to the pressing member across the fixing belt, and a heat generating member that is capable of being induction-heated and disposed along the inner surface of the fixing belt between a first position and a second position that is downstream with respect to the first position in a moving direction of the fixing belt. An upstream end portion of the resilient member in the moving direction is in contact with a third position of the fixing belt, and an angle formed with respect to the center by the second and third positions is equal to or smaller than 60°.

According to one or more embodiments, an image forming apparatus includes an image forming unit configured to form a toner image on a sheet and a fixing unit configured to fix the toner image on the sheet. The fixing unit includes a fixing belt configured to move around a center, a heating unit configured

to induction-heat the fixing belt, a pressing member that presses an outer surface of the fixing belt, a resilient member disposed opposite to the pressing member across the fixing belt and urged towards an inner surface of the fixing belt, and a heat generating member that is capable of being induction-heated and disposed along the inner surface of the fixing belt between a first position and a second position that is downstream with respect to the first position in a moving direction of the fixing belt. An upstream end portion of the resilient member in the moving direction is in contact with a third position of the fixing belt, and an angle formed with respect to the center by the second and third positions is equal to or smaller than 60°.

Throughout this description, the embodiments and examples shown should be considered as exemplars, rather than limitations on the apparatus and methods of the present invention.

Hereinafter, the fixer and the image forming apparatus will be described in detail using accompanying drawings as examples. In addition, the same element or the same portion in each figure will be given the same reference numeral, and redundant descriptions thereof will be omitted.

FIG. **1** illustrates an image forming apparatus according to an embodiment.

A multi functional peripheral (MFP) **10** includes a cassette **11**, a sheet feeding unit (sheet feeding device) **12**, a printing unit **13**, and a fixer (fixing unit) **14**.

The cassette **11** stores a bundle of sheets P. The sheet feeding unit **12** sends each of the sheets P (printing medium) to the printing unit **13**.

The printing unit **13** includes a yellow station **16**Y, a magenta station **16**M, a cyan station **16**C, and a black station **16**K.

The printing unit **13** further includes an intermediate transfer belt **17**, an exposure unit **18**, four primary transfer rollers **19**, a secondary transfer roller **20**, and a counter roller **21**.

The yellow station **16**Y is an image forming processing unit (image forming unit) for Y (yellow), and includes a photosensitive drum **22**, a charger **23**, a developing unit **24**, and a photoreceptor cleaner **25**.

The photosensitive drum **22** rotates in a direction of an arrow J. The charger **23** is a unit for charging, and charges the outer surface of the photosensitive drum **22**. The photosensitive drum **22** forms an electrostatic latent image on the outer surface of the photosensitive drum **22**.

The developing unit **24** visualizes the electrostatic latent image with toner. The photoreceptor cleaner **25** cleans toner which is left on the photosensitive drum **22**.

The magenta station **16**M is an image forming processing unit for M (magenta). The cyan station **16**C is an image forming processing unit for C (cyan). The black station **16**K is an image forming processing unit for K (black).

All of the magenta station **16**M, the cyan station **16**C, and the black station **16**K have substantially the same configuration as the yellow station **16**Y.

The intermediate transfer belt **17** endlessly moves in a direction of an arrow A in accordance with the rotation of the counter roller **21** or a roller **53**. A tension is applied to the intermediate transfer belt **17**.

The exposure unit **18** radiates laser light towards the yellow station **16**Y, the magenta station **16**M, the cyan station **16**C, and the black station **16**K, respectively.

Each primary transfer roller **19** causes the intermediate transfer belt **17** to be in contact with a corresponding photosensitive drum **22** while being urged downward. The intermediate transfer belt **17** and a sheet are nipped between the secondary transfer roller **20** and the counter roller **21**.

FIG. **2** illustrates the fixer **14**.

The fixer **14** causes a toner image to be fixed on a sheet which is sent in a sheet transport direction (direction of arrow D) using an endless fixing belt **31** which rotates in one direction (direction of arrow B), and a pressurizing roller **32** which rotates in one direction (direction of arrow C).

The fixer **14** includes an exciting coil **30** which generates a magnetic flux, and the fixing belt **31** that has a belt width, is provided so as to move in the arrow B, and is subjected to induction heating due to the magnetic flux generated by the exciting coil **30**.

In addition, the fixer **14** includes the pressurizing roller **32** (pressing member) which faces the fixing belt **31**, and a fixing pad **33** (urging member) which is provided along an inner surface **39** of the fixing belt **31** and urged to presses the fixing belt **31** towards the pressurizing roller **32**.

The fixer **14** further includes a heat generating element **34** which is in contact with the inner surface **39** of the fixing belt **31**, and generates heat due to the magnetic flux, and a magnetic flux shielding member **35**.

FIG. **3** is a perspective view of the heat generating element **34**. FIG. **4** illustrates a positional relationship between the heat generating element **34** and the fixing pad **33** on a plane. The heat generating element **34** includes a first end portion **59** and a second end portion **60** in a moving direction of the fixing belt **31**. The heat generating element **34** also includes one end **61** and the other end **62** which are respectively open, in a belt width direction which intersects the moving direction of the fixing belt **31**. The moving direction means a circumference direction of the fixing belt **31**.

The first end portion **59** is located at a first position P**1** downstream with respect to the fixing pad **33** in the moving direction, and the second end portion **60** is located at a second position P**2** which is downstream with respect to the first position P**1** in the moving direction.

An angle θ, which is formed by a first straight line L**1** which connects a center O of a circular locus which is drawn when one end of the fixing belt **31** in the belt width direction moves in the moving direction B of the fixing belt **31** and the second end portion **60** (second position P**2**), and a second straight line L**2** which connects the center O of the locus and a third position P**3** at which the fixing pad **33** is in contact with the fixing belt **31**, and which is downstream with respect to the second end portion **60** in the moving direction of the fixing belt **31**, is equal to or smaller than 60°. The angle θ may be equal to or smaller than 40°.

The center means a center of a locus which is drawn when one end of the fixing belt **31** that extends in the belt width direction moves along with the revolving movement of the fixing belt **31**.

Here, the center O, the first end portion **59**, the second end portion **60**, and a third end portion which is located at the third position P**3** of the fixing pad **33** are on the same plane. The angle θ is a central angle of an arc which is formed by the center O, P**2**, and P**3**.

The straight line L**1** connects the center O and P**2** on the plane. The straight line L**2** connects the center O and P**3**.

A shape of the other end **62** of the fixing belt **31** in the belt width direction is substantially the same as that of the one end **61**.

The positions P**1**, P**2**, and P**3** are inner circumferential positions of the fixing belt **31**. All of the positions P**1**, P**2**, and P**3** are on lines which are parallel to the belt width direction.

The second position P**2** corresponds to a position at which the heat generating element **34** ends at a downstream side in the revolving moving direction (direction of arrow B) of the fixing belt **31**. The downstream side denotes the downstream side with respect to the heat generating element **34**.

The third position P**3** corresponds to a position on the most upstream side of the fixing belt **31** in the revolving moving direction, at which an end portion of the fixing pad **33** is in contact with the inner surface **39**. The upstream side denotes the upstream side with respect to the fixing pad **33**.

The position P**3** is on a line on which the fixing belt **31** and the fixing pad **33** start to come into contact with each other in a contact region between the fixing pad **33** and the fixing belt **31** when the fixing belt **31** moves.

The exciting coil **30** in FIG. **2** includes a linear member **40** and a ferrite core **51**. The linear member **40** is wound around the ferrite core **51** along the width direction of the fixing belt **31**. The linear member **40** generates a fluctuating magnetic field when an alternating current is supplied. The ferrite core **51** increases density of a magnetic flux. The fixer **14** includes an induction heating circuit **58** (FIG. **1**) that is connected to the exciting coil **30**. The induction heating circuit **58** supplies an alternating current to the exciting coil **30**.

FIG. **5** is a top view of the fixer **14**. In the fixer **14**, the exciting coil **30** is apart from the outer surface of the fixing belt **31** with a clearance therebetween.

The fixing belt **31** includes a flexible base material **37** which moves around a center of the revolving, and a Cu layer (metal layer) formed on the outer surface of the base material **37**. The center of the revolving is parallel to a center of a bearing **50**.

The Cu layer **38** partially generates heat in the width direction thereof. The Cu layer **38** generates heat in a region (hereinafter, referred to as partial region R) which faces the exciting coil **30** of the entire region of the outer surface of the fixing belt **31**. A dimension of the partial region R in the width direction is substantially equal to a width of a sheet used in the image forming apparatus **10**. The sheet width is a dimension which is orthogonal to the sheet transport direction.

FIG. **6** illustrates a layer structure of the fixing belt **31**. The fixing belt **31** has a multilayered structure.

The fixing belt **31** includes a non-electrolytic Ni layer **41**, the Cu layer **38** (metal layer), an electrolytic Ni layer **42**, a heat resistant elastic layer **43**, and a releasing layer **44** that are formed on the base material **37** in this order.

The base material **37** is a cylindrical body with a diameter of 30 mm and a thickness of 70 μm. The base material **37** is formed of a material having a heat-resisting property, such as, polyimide (PI).

The non-electrolytic Ni layer **41** is disposed on the outer surface of the base material **37**, and has a thickness of 0.5 μm.

The Cu layer **38** is disposed on the outer surface of the non-electrolytic Ni layer **41**. The Cu layer **38** is a heat generating layer having a resistance that is sufficient to generate heat. The Cu layer **38** generates heat using an electromagnetic induction caused by a magnetic field generated by the exciting coil **30**. The thickness of the Cu layer **38** is 10 μm.

The electrolytic Ni layer **42** is present on the outer surface of the Cu layer **38**. The electrolytic Ni layer **42** is a protective layer with a thickness of 8 μm.

The heat resistant elastic layer **43** is coated on the outer surface of the electrolytic Ni layer **42**, with a thickness of 200 μm. The heat resistant elastic layer **43** may be made of a silicone (Si) rubber.

The releasing layer **44** covers the outer surface of the heat resistant elastic layer **43**. The releasing layer **44** may be a perfluoroalkoxy alkanes (PFA) tube with a thickness of 30 μm.

In FIG. **2**, the pressurizing roller **32** rotates in the direction of the arrow C. The pressurizing roller **32** is rotated by the fixing belt **31**.

The pressurizing roller **32** may include a core metal member **28**, an elastic layer **29** on the outer surface of the core metal member **28**, and a releasing layer **36** on the outer surface of the elastic layer **29**.

The core metal member **28** is an aluminum pipe, and an outer diameter thereof is 30 mm, hardness thereof is 65° (ASKER® TYPE with hardness C), and a thickness thereof is 3 mm. The elastic layer **29** is silicone sponge with a thickness of 8 mm. The releasing layer **36** is a PFA tube with a thickness of 30 μm.

In addition, the pressurizing roller **32** is longer than the exciting coil **30** in the belt width direction. The left end region and the right end region on the outer surface of the pressurizing roller **32** are in contact with the outer surface of the fixing belt **31** outside the partial region R of the fixing belt **31**.

The fixer **14** may include two spring coils **46** in the pressurizing roller **32**. The spring coil **46** applies to the pressurizing roller **32** a force urging toward the fixing belt **31**.

The fixer **14** may include a motor **47**. The motor **47** rotatably drives the pressurizing roller **32** through a gear **48**.

The fixing pad **33** is provided in an inner circumferential region which is different from an inner circumferential region to which tension is applied from the heat generating element **34** to the fixing belt **31** in the whole circumferential region of the inner surface **39**. The fixing belt **31** does not receive the tension from the heat generating element **34** in a range from the second position P**2** to the first position P**1**.

The fixing pad **33** is provided between the first position P**1** and the second position P**2**, and faces a nip region between the fixing belt **31** and the pressurizing roller **32**. A center of fixing pad **33** in a height direction thereof may be located at a center of the first position P**1** and the second position P**2**.

As illustrated in FIG. **5**, a force which is applied from the fixing pad **33** to the inner surface **39** of the fixing belt **31** contributes to form the nip region between the fixing belt **31** and the pressurizing roller **32**.

In the belt width direction, the fixing pad **33** is longer than the pressurizing roller **32**. In the belt width direction, the fixing pad **33** is shorter than the fixing belt **31**.

The fixer **14** may hold the fixing pad **33** in the fixing belt **31** using a stay **49**. Each end of the stay **49** penetrates a flange **45** disposed in each end of the fixing belt **31**. Each of the flanges **45** holds the stay **49** through the bearing **50**. Each tip end of the stay **49** is fixed to a housing **52** (FIG. **1**).

A material of the fixing pad **33** is a polyether ether keton resin (PEEK) or a heat-resistant phenol resin (PF).

As illustrated in FIG. **3**, the heat generating element **34** has a shape which is similar to that of the inner surface **39** of the fixing belt **31**.

The heat generating element **34** is a C-shaped cylindrical body which has a C-shape on one end face. The C-shape denotes that a part of a circular shape is lacked. The C-shaped cylindrical body is in contact with the inner surface **39** except for the lacked portion of which a central angle is equal to or less than 60°.

The heat generating element **34** has an outer surface **26**, and the outer surface **26** extends along the cylindrical shape of the fixing belt **31** in the belt width direction, and curves along the inner surface **39** of the fixing belt **31**.

The outer surface **26** is into contact with the inner surface **39** of the fixing belt **31**. The heat generating element **34** faces the exciting coil **30** across the fixing belt **31**.

In FIG. **4**, the angle θ, which is formed by a line passing through the second position P**2** of the heat generating element **34** and the center O and a line passing through the third position P**3** and the center O is set to be in a range in which a crack is not produced during a use of the Cu layer **38**.

In addition, the heat generating element **34** is formed of a metal material having temperature sensitive magnetism (temperature sensitive ferrite). Specifically, the heat generating element **34** is a magnetic shunt alloy.

The temperature sensitive ferrite has a magnetic property of being reversibly changed between ferromagnetism and nonmagnetism depending on a temperature range of the temperature sensitive ferrite (first temperature) which includes a fixing temperature.

The property of the heat generating element **34** is changed from ferromagnetism to nonmagnetism when the temperature of the temperature sensitive ferrite becomes higher than a temperature (second temperature) at which an amount of magnetic flux which penetrates the temperature sensitive ferrite is changed. The property of the heat generating element **34** is changed from nonmagnetism to ferromagnetism when the first temperature becomes lower than the second temperature. The fixer **14** adjusts the amount of heat generation according to the change of magnetism of the heat generating element **34**.

In addition, the fixer **14** includes the magnetic flux shielding member **35** in the inside of the C-shaped cylindrical body of the heat generating element **34**. In the fixer **14**, the heat generating element **34** is disposed between the magnetic flux shielding member **35** and the fixing belt **31**. The magnetic flux shielding member **35** urges the heat generating element **34** toward the fixing belt **31**. Aluminum is used for the magnetic flux shielding member **35**. The magnetic flux shielding member **35** prevents a noise caused by a magnetic flux around a sensor disposed in a space within the fixing belt **31**.

In addition, the fixer **14** has a separation guide **27** downstream with respect to the fixing pad **33** in the sheet transport direction D. The fixer **14** separates a sheet from the fixing belt **31** using a tip end of the separation guide **27**.

The fixer **14** includes a fixing belt thermistor **57** that detects a temperature based on which a magnetic flux of the exciting coil **30** is controlled. An output signal of the fixing belt thermistor **57** is sent to the induction heating circuit **58**.

Subsequently, operations of an image forming apparatus according to the embodiment with the above described configuration will be described.

The fixer **14** starts a warming-up process in response to turning on the MFP **10** (FIG. **1**) or transition of operational modes.

The pressurizing roller **32** pressurizes the fixing belt **31** towards the fixing pad **33**, being urged by the spring coils **46**. The pressurizing roller **32** rotates in the direction of the arrow C according to driving of the motor **47** through the gear **48**. The fixing belt **31** is rotated in the direction of the arrow D in accordance with the pressurizing roller **32**.

In the MFP **10** (FIG. **1**), the photosensitive drum **22** of the yellow station **16**Y rotates in the direction of the arrow J. The outer surface of the photosensitive drum. **22** is charged by the charger **23**. The exposure unit **18** radiates laser light towards the charged photosensitive drum **22**.

An electrostatic latent image is formed on the outer surface of the photosensitive drum **22** due to the exposure. The developing unit **24** develops the electrostatic latent image with yellow toner. Thus, the developing unit **24** visualizes the electrostatic latent image on the photosensitive drum **22** with yellow toner.

The toner image is conveyed on the photosensitive drum **22** as it rotates. In a transfer region of the yellow station **16**Y, the primary transfer roller **19** applies a bias voltage to the intermediate transfer belt **17**. The yellow station **16**Y primarily transfers the yellow toner image onto the intermediate transfer belt **17** through an operation of the bias voltage.

Toner which remains on the photosensitive drum **22** without being transferred is removed by the photoreceptor cleaner **25**. The photosensitive drum **22** is charged by the charger **23** again when rotating. The yellow station **16**Y repeats the operation from charging to the primary transfer.

The magenta station **16**M visualizes an electrostatic latent image with magenta toner by performing the same operation as that performed by the yellow station **16**Y. The cyan station **16**C visualizes an electrostatic latent image with a cyan toner. The black station **16**K visualizes an electrostatic latent image with a black toner.

A portion of the intermediate transfer belt **17** on which the yellow toner image is formed is transferred to a transfer region of the magenta station **16**M. At the magenta station **16**M, the magenta toner image is transferred to the portion of the intermediate transfer belt **17** on which the yellow toner image is formed.

The portion of the intermediate transfer belt **17** sequentially conveyed to each transfer region of the cyan station **16**C and the black station **16**K. At the cyan station **16**C and the black station **16**K, the cyan toner image and the black toner image are transferred to the portion of the intermediate transfer belt **17**, respectively.

On the other hand, the sheet feeding unit **12** picks up a sheet using a pair of pickup rollers **54** and a plurality of pair of transport rollers **55**. The sheet feeding unit **12** transports the sheet to a secondary transfer region in synchronization with formation of toner images of four colors using a pair of resist rollers **56**.

The secondary transfer region denotes a space which is formed at the intermediate transfer belt **17**, the secondary transfer roller **20**, and the counter roller **21**.

The secondary transfer roller **20** secondarily transfers the toner images on the intermediate transfer belt **17** onto the sheet by applying a bias current to the sheet. The secondary transfer roller **20** transfers the toner images of yellow, magenta, cyan, and black which are formed on the intermediate transfer belt **17** to the sheet.

A controller **15** respectively controls pickup timing of the sheet, timing of supplying the sheet to the printing unit **13**, timing of the primary transfer, and timing of the secondary transfer.

Subsequently, the secondary transfer roller **20** transports the sheet on which the toner images of each color are transferred, to the fixer **14**.

The pressurizing roller **32** causes a force to work between the pressurizing roller **32** and the fixing pad **33**. The pressurizing roller **32** applies a weight of approximately 350 N, being urged by the spring coils **46**, through the fixing belt **31**. A nip of 6.0 mm in the sheet transport direction is formed between the pressurizing roller **32** and the fixing belt **31**.

The fixer **14** causes toner to be melted while applying heat and a pressure to the sheet. The fixer **14** causes toner of each color to be fixed.

A cleaner (not illustrated) cleans toner remaining on the intermediate transfer belt **17** without being transferred.

As described above, an example of printing an image on one sheet using the MFP **10** is described.

Regarding the fixer **14**, in FIG. **2**, the exciting coil **30** generates a magnetic flux in accordance with a high frequency current applied thereto. The magnetic flux causes an eddy current in the Cu layer **38** of the fixing belt **31**. The Cu layer **38** generates Joule heat as the eddy current flows through the Cu layer **38** having a resistance. Thus, the fixing belt **31** with the Cu layer **38** can generate heat using the electromagnetic induction heating with the exciting coil **30**.

The fixer **14** includes the fixing belt thermistor **57** that is disposed on and in contact with the inner surface **39** of the fixing belt **31**. The fixing belt thermistor **57** detects a temperature at the inner surface **39** of the fixing belt **31**. The fixer **14** controls the temperature of the fixing belt **31** to be 150° C. to 160° C.

The heat generating element **34** generates heat by being electromagnetically induced by the magnetic field which is generated by the exciting coil **30**. The metal material having the temperature sensitive magnetism, which is used in the heat generating element **34**, has a property that reversibly transitions between ferromagnetism and nonmagnetism. The metal material having the temperature sensitive magnetism has a Curie point.

Relative permeability of the metal material having the temperature sensitive magnetism in a low temperature range rises as the temperature of the metal material rises. The relative permeability substantially decreases to zero when the temperature of the metal material exceeds the Curie point.

FIG. **7** is a chart illustrating a relationship between a central angle θ of the arc (i.e., lacked portion of the heat generating element **34**) on one end plane of the heat generating element **34** and life duration of the fixing belt **31**.

The life duration of the fixing belt **31** is an experimental result of durability of the fixing belt **31**. The figure in the right column of FIG. **7** denotes the number of sheets which have passed through the fixing belt **31** until a crack is generated in the fixing belt **31**. In the experiment, a process of conveying a plain sheet to the fixer **14**, pressurizing and heating the sheet by the fixer **14**, and discharging the sheet is continuously repeated.

In an experiment in which the fixer **14** having the heat generating element **34** with a central angle of θ which is equal to or less than 60° is used, a crack was not produced in the Cu layer **38** even when the number of sheets exceeds 200 k (200,000).

In an experiment in which the fixer **14** having the heat generating element **34** with a central angle of θ which exceeds 60° is used, a crack was produced in the Cu layer **38** before the number of sheets reached 200 k.

A cracked portion of the Cu layer **38** does not generate sufficient heat. The insufficient heat at the cracked portion may cause a partial fixing failure.

In addition, abnormal heating may occur at the periphery of the cracked portion of the Cu layer **38**. When the heat generating element **34** which causes the abnormal heating is continuously used, the Si rubber layer (heat resistant elastic layer **43**) and the PI base material (base material **37**) of the fixing belt **31** may be damaged.

In the fixer and the image forming apparatus according to the embodiment in which the central angle θ is 40°, the fixing belt **31** was not damaged even when sheets of 200 k have passed.

That is, the angle θ which is formed with a face passing through the second position P2 of the heat generating element **34** and the center O of the locus and a face passing through the third position P3 and the center O of the locus is 40°. As the fixing belt **31** is not damaged, life duration of the fixing belt **31** is longer.

When a fixing belt **31** of which angle θ is 20° was used, the fixing belt **31** was not damaged even when sheets of 200 k have passed. When a fixing belt **31** of which angle θ is 60° was used, the fixing belt **31** was not damaged even when sheets of 200 k have passed.

In the fixer and the image forming apparatus according to the embodiment, when the central angle θ was equal to or less than 60°, the fixing belt **31** was not damaged even when sheets of 200 k have passed. When target life duration of the fixing belt **31** is set to the point when 200 k of sheets are passed, it is possible to achieve the target life duration.

Accordingly, a crack is unlikely to be produced in the Cu layer **38** when using the fixing belt **31**. The fixing belt **31** is not excessively heated, and is not damaged.

Given these examples, the fixer **14** includes the fixing belt **31** (fixing member) which includes a metal layer and revolves, and the pressurizing roller **32** (pressurizing member) which is disposed with being in contact with the inner surface of the fixing belt **31** and is rotatably driven through the fixing belt **31**. The fixer **14** includes the fixing pad **33** (pressing member) which contributes to form a nip by being in contact with the pressurizing roller **32**, and the heat generating element **34** which is in contact with the inner surface **39** along the circumferential direction. An angle which is formed with a position at which heat generating element **34** ends and a position at which the fixing pad **33** starts to be in contact with the fixing belt **31** in the revolving direction is equal to or less than 60°.

In the above descriptions, the fixer **14** may be variously modified.

A pressurizing member other than the pressurizing roller **32** may be used. An urging member other than the fixing pad **33** may be used.

A contact area between the outer surface **26** and the inner surface **39** is predetermined according to a capacity of generated heat.

The angle θ may be denoted by rad.

The ASKER® TYPE C indicates hardness which is calculated using a durometer which is manufactured complying with a standard of Japanese Industrial Standards (JIS) K7312, or a standard of Society of Rubber Industry, Japan (SRIS) 0101.

The image forming apparatus according to the embodiment is a tandem system; however, the image forming apparatus may be a rotating type, for example. The image forming apparatus according to the embodiment may directly transfer a toner image to a sheet from the photosensitive drum **22**.

It is sufficient for the fixing belt **31** in FIG. **2** to include the Cu layer **38**, which is a heat generating layer. The fixing belt **31** may overlap the releasing layer **44** with the surface of the Cu layer **38**. The heat generating element **34** may have a plurality of slits. The heat generating element **34** may have a plurality of sub-heating elements which are divided in the belt width direction.

The metal layer is the Cu layer **38**; however, Fe or Ni may be used in the metal layer.

The electrolytic Ni layer **42** is provided on the Cu layer **38**; however, a separate Cu layer may be provided on the electrolytic Ni layer **42**.

The position of the fixing belt thermistor **57** is an example, and can be changed. Superiority of the image forming apparatus and the fixer according to the embodiment will not change even when these modifications are executed.

A temperature can be denoted using either Celsius or Fahrenheit.

Although exemplary embodiments of the present invention have been shown and described, it will be apparent to those having ordinary skill in the art that a number of changes, modifications, or alterations to the invention as described herein may be made, none of which depart from the spirit of the present invention. All such changes, modifications, and alterations should therefore be seen as within the scope of the present invention.

What is claimed is:

1. A fixer comprising:

a fixing belt configured to move around a center;

a heating unit configured to induction-heat the fixing belt;

a pressing member that presses an outer surface of the fixing belt;

a resilient member disposed opposite to the pressing member across the fixing belt; and

a heat generating member that is capable of being induction-heated and disposed along the inner surface of the fixing belt between a first position and a second position that is downstream with respect to the first position in a moving direction of the fixing belt,

wherein an upstream end portion of the resilient member in the moving direction is in contact with a third position of the fixing belt, and an angle formed with respect to the center by the second and third positions is equal to or smaller than 60°.

2. The fixer according to claim **1**, wherein

the angle is equal to or smaller than 40°.

3. The fixer according to claim **1**, wherein

the fixing belt includes a metal layer that is capable of being induction-heated.

4. The fixer according to claim **1**, wherein

the heat generating member has a nonmagnetic property or a ferromagnetic property depending on a temperature thereof.

5. The fixer according to claim **1**, wherein

an entire outer surface of the heat generating member is in contact with the fixing belt.

6. The fixer according to claim **1**, wherein

the heat generating member is formed in an arc shape.

7. The fixer according to claim **1**, further comprising:

a magnetic flux shielding member disposed along an inner surface of the heat generating member between the first position and the second position.

8. An image forming apparatus comprising:

an image forming unit configured to form a toner image on a sheet; and

a fixing unit configured to fix the toner image on the sheet, the fixing unit including,

a fixing belt configured to move around a center;

a heating unit configured to induction-heat the fixing belt,

a pressing member that presses an outer surface of the fixing belt,

a resilient member disposed opposite to the pressing member across the fixing belt and urged towards an inner surface of the fixing belt, and

a heat generating member that is capable of being induction-heated and disposed along the inner surface of the fixing belt between a first position and a second position that is downstream with respect to the first position in a moving direction of the fixing belt,

wherein an upstream end portion of the resilient member in the moving direction is in contact with a third position of the fixing belt, and an angle formed with respect to the center by the second and third positions is equal to or smaller than 60°.

9. The image forming apparatus according to claim **8**, wherein

the angle is equal to or smaller than 40°.

10. The image forming apparatus according to claim **8**, wherein the fixing belt includes a metal layer that is capable of being induction-heated.

11. The image forming apparatus according to claim **8**, wherein

the heat generating member has a nonmagnetic property or a ferromagnetic property depending on a temperature thereof.

12. The image forming apparatus according to claim **8**, wherein

an entire outer surface of the heat generating member is in contact with the fixing belt.

13. The image forming apparatus according to claim **8**, wherein

the heat generating member is formed in an arc shape.

14. The image forming apparatus according to claim **8**, further comprising:

a magnetic flux shielding member disposed along an inner surface of the heat generating member between the first position and the second position.

15. A fixer comprising:

an endless belt configured to move around a center;

an induction heater for the endless belt;

a resilient member disposed along an inner surface of a first portion of the endless belt;

a pressing member configured to press an outer surface of the endless belt against the resilient member to form a nip between the pressing member and the outer surface of the endless belt; and

a heat generating member configured to generate heat in response to the induction heater, and arranged along an inner surface of a second portion of the endless belt that is different from the first portion and separated from the first portion, wherein an angle formed with respect to the center by a downstream end of the heat generating member and an upstream end of the first portion, in a moving direction of the endless belt, is equal to or smaller than 60°.

16. The fixer according to claim **15**, wherein

the endless belt includes a metal layer that generates heat in response to the induction heater.

17. The fixer according to claim **15**, wherein

the heat generating member has a nonmagnetic property or a ferromagnetic property depending on a temperature thereof.

18. The fixer according to claim **15**, wherein

an entire outer surface of the heat generating member is in contact with the endless belt.

19. The fixer according to claim **15**, wherein

the heat generating member is formed in an arc shape.

20. The fixer according to claim **15**, further comprising:

a magnetic flux shielding member disposed along an inner surface of the heat generating member.

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